Lead in Soil: Is Your Backyard Safer than a Hazardous Waste Site?

by Randall Lutter and Elizabeth Mader

EPA mandates cleanup of lead-contaminated soil at hazardous waste sites even if concentrations of lead are much lower than those allowed by residential lead hazard standards. Yet the likelihood of children's exposure to lead, which is regarded as the main environmental health hazard facing children in the United States today, is much higher in backyards than at hazardous waste sites. This article recommends policies to regulate lead in soil that would both reduce costs and improve children's health.

INTRODUCTION

An amazing variety of federal programs address lead hazards. Currently, four government agencies regulate lead exposure by administering eight programs under eight statutes (see "Federal Programs Regulating Lead Hazards"). Even a specific hazard like lead-contaminated soil falls within the jurisdiction of two different agencies and four distinct statutes. Some observers believe the multiplicity of programs is a source of problems with regulatory efforts.[1] Lead is generally regarded as the main environmental hazard facing children in the United States, and as a result, policy-makers nationwide are launching even more initiatives to protect children from exposure to lead. For example, to meet a goal of eliminating elevated blood-lead levels in children by 2010,[2] the federal budget for 2001 provided for a 50% increase in lead hazard control grants issued by the U.S. Department of Housing and Urban Development (HUD).[3] The office of the Governor of Maryland recently announced a $50 million plan to dramatically reduce child lead poisoning in Baltimore.[4] And in December 2000, the U.S. Environmental Protection Agency (EPA) issued new standards for regulating lead in private homes.[5-7] These efforts target deteriorated lead-based paint and lead in dust or soil that came from lead-based paint, which was banned from sale in 1978 but is still present in many older U.S. residences.

We evaluate lead policies for sites regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, better known as Superfund)[8] and the Resource Conservation and Recovery Act (RCRA),[9] and for private residences according to new EPA regulations issued in December 2000[7] and HUD's regulations for federally assisted housing.[10] For simplicity, our assessment will be limited to the regulation of lead in soil.

FEDERAL PROGRAMS REGULATING LEAD IN SOIL

Lead-based paint in older houses is now a direct and indirect source of most children's exposure to lead.[7] High levels of lead found in soil in residential areas are generally the result of deterioration of now-banned lead-based paint, while lead contamination in industrial settings is more likely the result of smelting, mining, recycling, and other industrial activities. Young children can be exposed to lead in soil either directly through ingestion during outdoor play activities or indirectly when lead from soil is tracked indoors, where it can accumulate as lead dust. We know of no reason to believe that the bioavailability of lead at nonresidential sites is greater than at residential sites. Indeed, a pooled analysis by Lanphear et al. included a variable to "flag" industrial, mining, or smelter communities. Although there were differences in predicted blood-lead levels among the different communities, the authors report that "the predominant factor accounting for these differences appeared to be degree of urbanization and, to a lesser extent, the year in which the study was conducted."[11]

The fact that many Superfund and RCRA sites have few, if any, residents limits the cost-effectiveness of control efforts at these sites. Hamilton and Viscusi found only 12% of the 150 Superfund sites they studied had residents living on-site,[12] and because RCRA sites have permits to manage hazardous wastes, they typically do not have residents living on-site. Although EPA directs decision-makers at Superfund sites to select remedies to "reflect the reasonably anticipated future land use or uses,"[13] in practice, the agency often makes conservative estimates of *potential* on-site populations, which result in maximum cumulative risk estimates that Hamilton and Viscusi deem hypothetical because they involve a change in land use.[12] Moreover, EPA places deed restrictions on many sites to prohibit future land uses that would expose people to residual risks (see Table 1).

Although there are no estimates of the costs of abating lead at these sites, costs are likely to be high. Lead is a contaminant at more than one third of the nearly 1300 sites on the CERCLA National Priorities List,[14] making it one of the most common contaminants at Superfund sites nationwide.[15] The overall cost of Superfund in its first 12 years was approximately $20 billion, although only 40 sites were fully remediated. According to the Congressional Budget Office, the base-case present value of the costs of cleaning up nonfederal Superfund sites after 1992 will be about $75 billion.[16] (Note that this figure assumes a 7% discount rate. The base-case estimate assumes that EPA will ultimately place 4500 nonfederal sites on the National Priorities List.)

EPA's policies to control lead at Superfund sites are more stringent than its new residential lead standards (or HUD's residential standards). At Superfund sites, EPA often requires remediation if lead concentrations in soil are at or below 1000 parts per million (ppm).[17,18] This cleanup level—the minimum concentration at which remediation is required—is more stringent than the 1200-ppm residential standard for lead in soil recently issued by EPA. (This standard applies to bare soil outside of play areas. EPA also set a 400-ppm standard for "play areas" defined as areas "of frequent soil contact by children of less than six years of age...."[19] We will refer here to the residential standard of 1200 ppm because we believe it is reasonable to expect that children will have some exposure from the entire yard.) Only three of the 14 Superfund sites we identified had people reported to be in residence, while 11 of these sites had either no residences or no information about residences (see Table 1). The type of cleanup required at each of those sites is as protective as required by EPA or HUD residential regulations. In every case but one, remediation involved excavation and/or treatment, while the EPA and HUD residential standards require removal or permanent cover such as pavement or concrete.[20] Finally, in more than 70% of the sites where no children are indicated to be present, EPA restricts future land uses that might allow children to be present. Thus at sites without children present, the Superfund program requires lead cleanup more protective than at residential sites.

Although EPA does not post comparable site-specific information about lead cleanup at RCRA sites in a searchable online database, its management of these sites is likely to be similar because the guidance document that established lead abatement policies for Superfund sites also applies to RCRA.[17] For example, EPA reports that RCRA cleanup standards at the Sherwin-Williams Company facility are removal and replacement of residential soil with concentrations of lead greater than 1000 ppm.[21]

EPA POLICY

There are several problems with EPA's regulation of lead in soil under Superfund and RCRA. First, RCRA and Superfund policies to clean up lead in soil at concentrations well below 1200 ppm are inefficient because young children are typically not present at sites regulated under these policies. Reducing residential lead hazards is more cost-effective because young children, the significant at-risk population, are exposed to such hazards. Second, EPA's policy is unfair, insofar as owners of low-risk properties are subject to more stringent cleanup standards. Under current regulations, backyards contaminated by lead in concentrations below 1200 ppm are not deemed hazardous. Superfund sites, however, often must be cleaned up even if concentrations are only hundreds of parts per million and there are no children present. Third, EPA's standards for lead may confuse the public about the actual risk posed by lead in soil. Lead standards that are more stringent at industrial sites, where potential exposure is lower than at residential sites, are unlikely to help EPA in its risk-communication goals of "promoting credibility and trust…and making complex technical data and policy information more accessible."[22]

STUDY OF LEAD IN SOIL AT SELECT SUPERFUND SITES

EPA often requires remediation of Superfund sites even if lead concentrations in soil are less than or equal to 1000 ppm, a level more stringent than necessary to meet EPA's residential lead hazard standards. In this section, we analyze the remediation of lead in soil at a set of sites included in the National Priorities List (NPL) in March 2000. We limit our investigation to the Records of Decision (RODs) and site descriptions available through the EPA's Superfund online database at *http://www.epa.gov/superfund/sites/*.

Our research differs from the monumental review of the Superfund program conducted by Hamilton and Viscusi, who considered the costs and benefits of reducing cancer risks posed by all identified carcinogens and all identified exposure pathways; they examined 267 nonfederal sites that had RODs signed in 1991 or 1992.[12,23] In contrast, we consider all sites with RODs signed during any period, but limit our focus to lead in soil.
We were unable to construct a random sample of sites on the NPL with numeric cleanup standards for lead in soil. An initial inspection of RODs from a random sample of 12 of the 465 sites where lead is listed as a contaminant of concern in soil indicated that only one had a numeric cleanup level reported for lead in soil. If only one in 12 sites have numeric

cleanup levels, constructing a random sample of 38 sites with numeric cleanup levels for lead might require examining the RODs for all 465 sites in the NPL database, a task that is beyond our resources.

Even an exhaustive examination of the RODs for all 465 sites is unlikely to provide representative information about the severity of cleanup standards for lead in soil. Officials responsible for drafting RODs may choose not to report numeric cleanup levels of lead for several reasons. First, the presence of other contaminants may drive cleanup decisions (for an example, see the ROD dated July 14, 1992, for Ciba-Geigy [ALD001221902]). Second, they may consider the numeric levels unimportant details of site management. Third, they may not report numeric cleanup levels because doing so might attract critics who would complain that the levels are too high or too low. As a result, sites that have numeric cleanup levels reported for lead may not be representative of all sites.

We constructed our sample by looking for sites with numeric cleanup levels for lead that are more stringent than 1200 ppm. While some of these sites have people in residence, the RODs for most sites provide no information about resident populations. We believe, however, that it is unlikely there is a resident population present at such sites because site managers have incentives to report resident populations in order to show that they are taking appropriately protective measures. Hamilton and Viscusi found that only 12% of Superfund sites they studied had resident populations.[12]

Although we focus on examples of comparatively stringent cleanup levels, we did find RODs for emergency responses at less stringent cleanup levels. For example, the RODs for the Oronogo-Duenweg Mining Belt (MOD980686281) state that a "time-critical removal" was conducted at residences where children exhibited high blood-lead concentrations or where soil levels exceeded 2500 ppm. In the same action, EPA set a cleanup level of 500 ppm at daycare centers. Table 1 presents information for sites with cleanup levels more stringent than residential lead standards. EPA specifies institutional controls at many of the sites listed, including deed restrictions on land use, which preclude the possibility of future residential use. Three of the sites (listed at the bottom of the chart) contain land put to residential use. In these cases, the cleanup levels were far more protective than the residential lead standards of EPA and HUD.
Excavation and removal is the most common remediation contaminated soil varies. This treatment is essentially the same as is required by EPA's residential lead program, which states that abatement consists of measures to permanently eliminate lead-based paint hazards such as removal or cover, where a permanent cover is defined as a barrier of solid, relatively impermeable material, such as pavement or concrete, with grass, mulch, and other landscaping materials not qualifying.[24] EPA's rule implementing TSCA Section 403 requires that if soil is removed it must be replaced with soil with lead concentrations no greater than 400 ppm.[20]

The cost of remediation cannot be entirely attributed to lead cleanup because the presence of other contaminants at the site may justify remediation. Some costs are also incurred for off-site remediation, where residents may or may not be present. The costs listed in Table 1 are "estimated present value" costs from the RODs unless otherwise noted and are presumably calculated in the dollars corresponding to the date of the ROD.

Table 1 also reports information on whether the RODs list concerns with groundwater contamination for each site. While concerns with groundwater could justify more stringent cleanup standards, we cannot assess the risk from lead in groundwater or the relative stringency of cleanup efforts compared with EPA's regulation of lead in drinking water because RODs rarely provide information on such risks. We note, however, that Lanphear et al., in their pooled analysis, estimate an effect of lead in drinking water on children's blood-lead levels that is statistically insignificant and much smaller than the effect of indoor dust lead or exterior lead.[11]

CONCLUSIONS AND RECOMMENDATIONS

To focus remediation efforts where they will best protect America's children, we recommend that cleanup standards for lead in soil at Superfund and RCRA sites should not be more stringent than residential standards. It makes little sense to excavate and treat lead-contaminated soil at unpopulated Superfund and RCRA sites, if the lead concentrations are low enough to be acceptable in the backyards of people's homes. EPA should relax the stringency of its RCRA and Superfund lead policies to a level no more stringent than 5000 ppm; EPA's own empirical model indicates that no standard more stringent than 5000 ppm has positive net benefits.[5]

EPA's empirical model overstates the benefits of soil-lead abatement, however, because EPA's empirical model assumes an effect of soil in lead on blood-lead levels that is much larger than Lanphear et al. estimate in their meta-analysis of all empirical studies of the determinants of blood-lead levels.[25] Lanphear et al. estimate that soil-lead concentrations have an effect on blood-lead levels almost five times smaller than the effect assumed in EPA's empirical model (a coefficient of 0.021 instead of 0.11). Thus, residential standards for lead in soil more stringent than 2000 ppm will not cost-effectively protect children's health (for a more detailed discussion, see Lutter [1999]).[26]

EPA should focus abatement efforts on indoor residential dust, which is the most important cause of elevated blood-lead in children.[25,27] As CERCLA and RCRA lead in soil hazard guidance states, "Addressing exposure from other sources of lead [than soil] may reduce risk to a greater extent and yet be less expensive than directly remediating soil."[17]

Some reforms could *simultaneously* lower compliance cost and improve children's health. For example, if parties financially liable for cleaning up Superfund sites could clean up lead dust in people's homes *instead* of meeting EPA's costly on-site lead cleanup standards, then compliance costs would fall and children's health would improve relative to current policies. In such a scenario, cleanup standards at unpopulated Superfund sites might be revised to 5000 ppm, and half of the resulting cost savings could be spent removing lead dust from nearby homes.

Indeed, TSCA, CERCLA, and RCRA grant EPA discretion to revise its standards. CERCLA directs EPA to "promulgate and revise as may be appropriate, regulations designating as hazardous…[substances] that, when released into the environment may present substantial danger to the public health or welfare or the environment…"[30] RCRA directs EPA to establish performance standards "as may be necessary to protect human health and the environment"[31] and defines a hazardous waste as a solid waste which may "pose a substantial present or potential hazard to human health or the environment."[32] Since EPA has chosen to set lead cleanup levels at Superfund and RCRA sites through an informal guidance recommending site-by-site risk analysis, it may be able to change the guidance without going through the regulatory comment and review process.

We find that the more stringent regulations perversely apply to sites where children's exposure to lead is least likely. Although EPA has issued new voluntary standards for soil in residential backyards, the agency requires hazardous waste sites (without any residents) to meet much more stringent standards, which EPA regulates under CERCLA and RCRA. The low likelihood of children's exposure at these sites means that remediation is likely to be exceptionally costly relative to the expected improvements in children's health. By applying the results of EPA's recent cost-benefit analysis of residential lead hazards to its programs regulating lead in soil at nonresidential sites, we argue that these nonresidential standards are unlikely to offer net benefits. Based on our assessment, we recommend changes to EPA's regulatory programs to improve their cost-effectiveness and make them more consistent with other federal regulatory efforts.

After assessing whether the paradoxes among the regulatory programs are attributable to the underlying statutes or whether they instead result from EPA's own decisions, we conclude that reform efforts cannot rely solely on agency discretion, since the inconsistency in federal regulation of lead in soil has occurred despite the extensive discretionary authority granted by underlying statutes. Agencies have enjoyed broad latitude since the U.S. Supreme Court's decision in *Chevron USA Inc. vs. Natural Resources Defense Council Inc*.[33] In that case, the Court ruled that if a regulatory statute is silent or ambiguous with respect to a specific issue, the only question for a court is whether the agency's construction of the statute is *permissible*.

The perverse inconsistencies among EPA's programs regulating lead in soil result from EPA's own decisions and not the underlying statutes. Environmental programs will not adhere to basic principles such as greater stringency for greater potential exposure unless Congress and the public demand it.

Sidebar: Please box

Federal Programs Regulating Lead Hazards

- **The U.S. Consumer Product Safety Commission (CPSC)** regulates lead in consumer products under the Federal Hazardous Substances Act.

- **The U.S. Environmental Protection Agency (EPA)** regulates lead around the home under the Toxic Substances Control Act; lead in air under the Clean Air Act; lead in drinking water under the Safe Drinking Water Act; and lead in hazardous waste sites under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA).
- **The U.S. Food and Drug Administration (FDA)** regulates lead in food containers and bottled water under the Food and Drug Act.
- **The U.S. Department of Housing and Urban Development (HUD)** regulates lead in federally assisted housing under the Residential Lead-Based Paint Hazard Reduction Act, which amends the Toxic Substances Control Act to add Section 403 and other provisions.

[[sidebar box ends]]

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Table 1. Summary of lead abatement actions at 14 Superfund sites.

Source: Records of decision and site descriptions from EPA's Superfund database, http://www.epa.gov/superfund/sites/.

Site No.	Site Location and Date(s) of Decision(s)	Site Name and EPA ID Number	Soil-Lead Cleanup Level	Action	On-site/Nearby Residents and Land Use	Groundwater Concerns	Future Land Use Controls	Estimated Remediation Costs
1	California 09/26/89	Beckman Instruments CAD048645444	200 ppm	Excavation and off-site disposal	No mention; population off-site drinks groundwater affected by site	Groundwater VOC contamination separate from lead in soil	No mention	$4.7 million
2	Massachusetts 09/08/83	Industri-Plex MAD076480950	300 ppm	Caps, such as concrete or asphalt	No mention; off-site within 1000 ft.	Groundwater concerns stem from VOCs and arsenic	Future land use restricted to industrial/ commercial	Not given
3	New Jersey 07/08/94	NL Industries NJD061843249	500 ppm	Excavation, treatment, and on-site disposal	No mention; 1700 residents in township	Yes (overlies potable water aquifer)	No mention	$19 million
4	Georgia 05/07/93	Cedartown Industries, Inc. GAD095840674	500 ppm	Excavation, treatment, and on-site disposal	No mention; site is in agricultural/ industrial area	Groundwater concerns stem from VOCs and other organics in the water; lead not mentioned	Deed restrictions will preclude use of groundwater and minimize land use	$3.4 million

5	Pennsylvania 09/30/92	C&D Recycling PAD021449244	500 ppm	Excavation, treatment, and off-site disposal	No mention; residential and agricultural surroundings	Groundwater underlies the site, but no mention of lead leaching	Ensure public knowledge and restrict land use	$12 million
6	Virginia 09/29/92 and 08/15/94	Abex Corp. VAD980551683	500 ppm surface; 1000 ppm to watertable	Excavation and disposal on-site and at homes within 700 ft.	No mention; nearby residences	No mention	No mention	$29 million
7	Ohio 10/26/86 and 0/18/970	Arcanum Iron and Metal OHD017506171	500 ppm on-site; background levels off-site	Excavation and off-site disposal	No mention; nearby residences	Lead detected in monitoring wells but not residential wells	Deed restrictions on land and aquifer use	$9.9 million capital; $37,000 operation and maintenance (O&M)
8	Florida 06/30/92 and 03/30/94	Florida Steel Corp. FLD050432251	600 ppm	Excavation and off-site disposal	No mention; surrounding area is mixed industrial and agricultural	Goals based on "leachability of lead from soil into underlying groundwater"	Deed restrictions on future use	$7 million
9	New Mexico 09/29/92	Cal West Metals NMD097960272	640 ppm	Treatment and on-site disposal	No mention; 3 homes within 1100 ft.	Lead found in groundwater	No mention	$1.6 million
10	Florida 03/13/86	Pepper Steel FLD032544587	1000 ppm	Treatment and on-site disposal	No mention; "unsewered industrial area"	Referenced in Biscayne Aquifer ROD	Institutional controls to ensure "compatibility"	$5.2 million capital; $43,000 O&M

11	Virginia 03/30/90	C&R Battery VAD049957913	1000 ppm background level (2 responses)	Excavation, treatment, and landfill disposal above 1000 ppm; cover all soil with lead above background level	No mention; site is surrounded by open fields, woods, and industrial sites	Lead and arsenic in groundwater	"Appropriate site use restrictions" will be put in place	$16 million
12	Illinois 03/30/90	NL Industries/ Taracorp. ILD096731468	500 ppm off-site residential; 1000 ppm off-site other	Excavation and on-site disposal	No mention; residents adjacent to site	Groundwater will be monitored during cleanup; no present problems	Deed restrictions will prevent disturbance of on-site storage	$30 million
13	Idaho 08/30/91	Bunker Hill Mining IDD048340921	1000 ppm at on-site homes	Excavation on-site capped disposal	1800 on-site homes	No mention	Deed and land-use restrictions	$93 million (for 2 RODs)
14	Texas 05/09/95	RSR Corp. TXD079348397	1000 ppm residential	Excavation and replacement	17,000 people on-site	No action taken	No mention	Not given

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